PRIS Home



Superfund

PRG Search

The Data are current as of March 2001

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Radionuclides and PRGs You Selected:

FAQ

NOTE: If this page is too wide to print, try selecting a smaller font or printing in landscape mode.

WARNING: The Base Product product with which Session Manager is associated will expire within 30 days. Please contact your to have it renewed. WARNING: The Base Product product with which Program /web/prod/cgi-bin/epa-prgs/rad 0105.sas is assoc

Please contact your SAS installation representative to have it renewed.

Radionuclide	Agricultural Soil (pCi/g)	Agricultural Soil (mg/kg)	Ingestion	Ingestion		Worker Soil	Soil	Soil
Ra-226+D decaychain	. 8.07E-04	8.17E-10	3.42E-03	3.47E-09	2.48E-02	2.51E-08	9.33E-03	9.45E-09

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This page was last updated on: August 21, 2001
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PRE-Home

SEPA United States Environmental Protection Agency

Superfund

PRG Search

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FAO

Equations

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SELECTION:

Your Analytes/CAS numbers are:

Ra-226+D

Your PRGs are

Residential Soil
Outdoor Worker Soil
Indoor Worker Soil
Tap Water
Fish Ingestion
Soil to Ground Water
Agricultural Soil

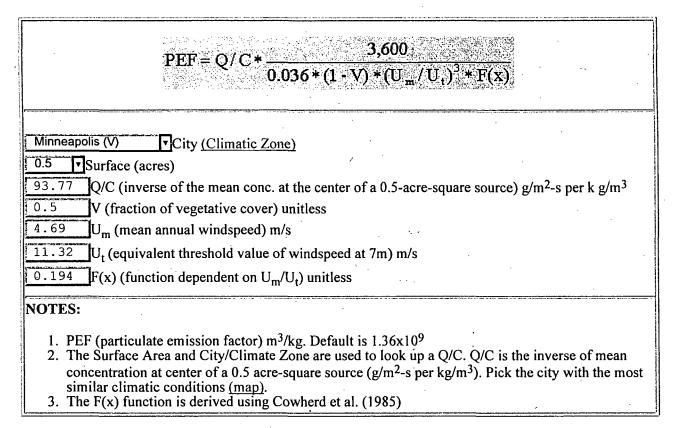
Your Units are pCi

Default Parameters

Each PRG you have selected is given below along with the applicable Equations and its associated Default Parameters. For each equation, the default values will be used unless you enter a different value.

Particulate Emission Factor

(needed for Residential Soil, Agricultural Soil, Outdoor Worker Soil, and/or Indoor Worker Soil)



K_d values from Technical Background Document.

(Needed for Agricultural Soil and/or Soil to Ground Water.)

Americium	8.2	Cadmium	2.7	Carbon	0.8	Cerium	35	Cesium	10
Cobalt	0.1	Curium	86	Hydrogen	0	Iodine	0.03	Iron	3.1
Lead	6	Manganese	4.9	Neptunium	0.1	Nickel	34	Plutonium	5
Radium	3	Radon	0	Ruthenium	5	Silver	2.7	Strontium	1
Technetium	0.007	Thorium	20	Uranium	0.4	Zinc	0.1		•
User-provided site-specific K _d values.									
Actinium		Antimony	-	Bismuth [Chlorine		Europiu	ım
Gadolinium		Niobium		Potassium [P	romethiu	ım 🔼	Protacti	nium
Samarium		Sodium		Thallium [

Residential Soil

	Radionuclide (Contaminants in Soil
C(pci/g) =		$TR \times t \times \lambda$
	SF _s × IR _s × 10 ⁻³ (g/mg)×EF)	$+\left(SF_{1}\times IR_{1}\times \frac{10^{3}(g/kg)}{5^{3}PEF}\times EF\times \left[ET_{0}+\left(ET_{1}\times DF_{1}\right)\right]\right)+\cdots$
EI		
	$\left[SF_{e} \times \frac{7}{365 (d/yr)} \times ACF \times ET \right]$	$(+(ET_i \times GSF_i))$ + $(SF_p \times (CR_f + CR_p) \times 10^3 (g/kg) \times TF_p \times CPF)$
Where:		
	IR C = ED EXIR + ED XIR	IR; = ED; ×IRA; + ED; ×IRA;
_	ED SO	ED VCP LED VCP
	CR v = ED & C. vc ED & C. vc	CRY = ED CONE

1.0E-6 TR (target risk) unitless	t (time of exposure) yr
ED (exposure duration, $ED_c + ED_a$) yr	EF (exposure frequency) d/yr
0.073 ET _o (exposure time fraction, outdoor) unitless	0.683 ET _i (exposure time fraction, indoor) unitless
DF _i (indoor dilution factor) unitless	0.9 ACF (area correction factor) unitless
GSF (gamma shielding factor) unitless	0.25 CPF (contaminated plant fraction) unitless
6 ED _c (exposure duration, child) yr	ED _a (exposure duration, adult) yr
IR _c (soil intake rate, child) mg/day	IR _a (soil intake rate, adult) mg/day
IRA _c (inhalation rate, child) m ³ /day	IRA _a (inhalation rate, adult) m ³ /day
CR _{fc} (fruit consumption rate, child) kg/yr	CR _{fa} (fruit consumption rate, adult) kg/yr
28 CR _{vc} (vegetable consumption rate, child) kg/yr	79.6 CR _{va} (vegetable consumption rate, adult) kg/yr

NOTES:

- 1. SF_s=soil ingestion slope factor (Risk/pCi). radionuclide-specific
- 2. SF_i=inhalation slope factor (Risk/pCi). radionuclide-specific
- 3. SF_e=external exposure slope factor (Risk/yr per pCi/g). radionuclide-specific
- 4. SF_p=food ingestion slope factor (Risk/pCi). radionuclide-specific
- 5. IR = age-adjusted ingestion rate (mg/day).
- 6. IR;=age-adjusted inhalation rate (m³/day).
- 7. CR_f=age-adjusted fruit consumption rate (kg/yr).
- 8. CR_v=age-adjusted vegetable consumption rate (kg/yr).
- 9. PEF=particulate emission factor (m³/kg).
 10. TF_p=soil-to-plant transfer factor. radionuclide-specific
- 11. \(\lambda = \text{Decay constant (0.693/halflife) yr^1}.\) Radionuclide-specific.
 12. The curie (Ci), the customary unit of activity, is equal to 3.7 x 10¹⁰ nuclear transformations per second.

1 picocurie (pCi) = 10^{-12} Ci. The International System (SI) unit of activity is the becquerel (1 Bq =1 nuclear transformation per second).

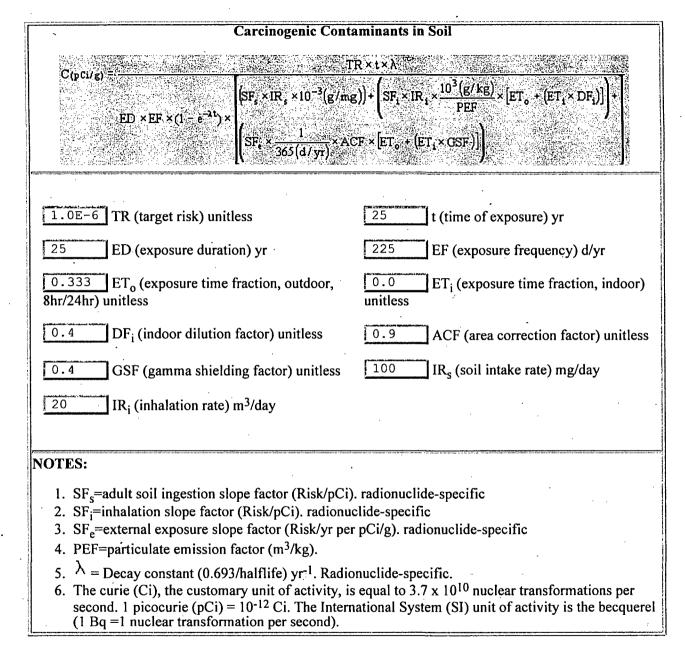
Agricultural Soil

Radionuclide Contaminants in Agricultural Products TR×t×λ $ED_{+} \times (1 - e^{-2t}) \times [ING_{+} + INH_{+} + EXT_{+} + PROD_{+} + FISH_{+} + MEAT_{+} + MILK]$ Where: $EXT_{s(g/pCi-yr)} = \frac{Er}{365 d/yr} \times ACF \times [ET_o + (ET_i \times GSF)] \times SF_o$ $ING_{s(g/pCi-yz)} = IR_s \times EF \times SF_s \times 10^{-3} (g/mg)$ $\text{INH}_{s(g/p\text{Ci-yr)}} = \text{IR}_i \times \text{EF} \times \left[\text{ET}_o + \left(\text{ET}_i \times \text{DF}_i\right)\right] \times \text{SF}_i \times \frac{10^3 (g/\text{kg})}{\text{DEF}}$ $PROD_{(g/pCi-yi)}^{\circ} = (CR_f + CR_{\pi}) \times TF_p \times CPF \times SF_f \times 10^{3} (g/kg) \quad FISH_{(g/pCi-yi)} = IR_f \times SF_f \times 10^{3} (g/kg)$ $MEAT_{(g/pCi-yz)} = \left([R_b] + [R_p] \times \left([TF_b \times FI_b] \times TF_p\right) + \left([TF_b \times FI_{ab}\right) + \left[TF_b \times FI_{wb} \times \frac{1}{\left(K_a + \sigma \times \left(\frac{S}{\sigma}\right)\right)} \times \frac{1}{DF_w}\right] \times SF_f \times 10^3 (g/kg)$ $MILK_{(g/\bar{p}Ci-yr)} = IR_{m} \times \left[TF_{m} \times FI_{m} \times TF_{p} \right) + \left[TF_{m} \times FI_{mn} \right) + \left[TF_{m} \times FI_{wm} \times \frac{1}{\left| K_{d} + \sigma \times \left(\frac{S}{\sigma} \right) \right|} \right] \times \frac{1}{DF_{w}} \right] \times SF_{f} \times 10^{3} (g/kg)$ IR, = ED, ×IR, +ED, ×IR, $IR_{i} = \frac{ED_{i} \times IRA_{i} + ED_{i} \times IRA_{i}}{FD}$ CR = ED c × CR vc + ED a × CR va ED CR, = ED & CR, +ED X CR, IR, = ED x IR + ED x IR . $IR_{b} = \frac{ED_{c} \times IR_{bc} + ED_{a} \times IR_{ba}}{ED}$ $IR_{\mathbf{p}} = \frac{ED_{c} \times IR_{\mathbf{p}c} + ED_{a} \times IR_{\mathbf{p}a}}{ED}$

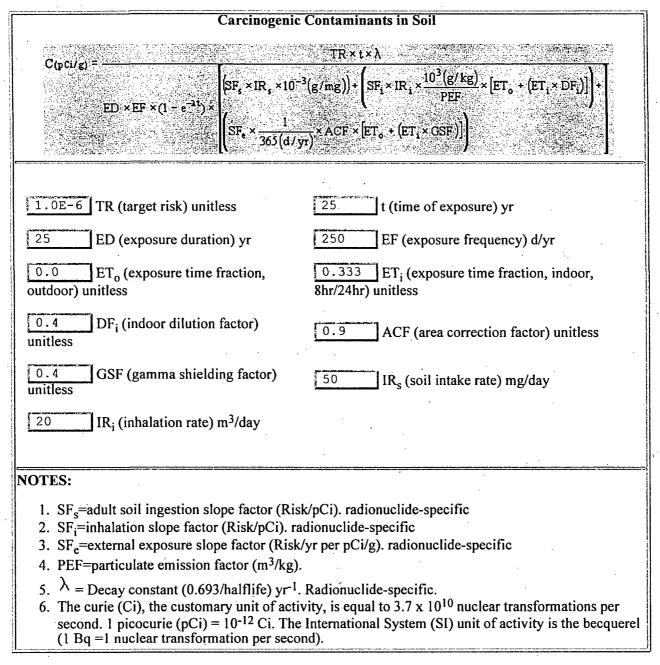
1.0E-6 TR (target risk) unitless	t (time of exposure) yr
ED (exposure duration, $ED_c + ED_a$) yr	CPF (contaminated plant fraction) unitless
EF (exposure frequency day/yr	0.073 ET _o (exposure time fraction, outdoor) unitless
0.683 ET _i (exposure time fraction, indoor) unitless	DF _i (indoor dilution factor) unitless
ACF (area correction factor) unitless	GSF (gamma shielding factor) unitless
6 ED _c (exposure duration, child) yr	ED _a (exposure duration, adult) yr
IR _{sc} (child soil intake rate) mg/day	100 IR _{sa} (adult soil intake rate) mg/day
IRA _c (child inhalation rate) m ³ /day	IRA _a (adult inhalation rate) m ³ /day
28 CR _{vc} (child vegetable consumption rate) kg/yr dry weight	79.6 CR _{va} (adult vegetable consumption rate) kg/yr dry weight
CR _{fc} (child fruit consumption rate) kg/yr dry weight	CR _{fa} (adult fruit consumption rate) kg/yr dry weight
6.4 IR _{fc} (child fish ingestion rate) kg/yr	IR _{fa} (adult fish ingestion rate) kg/yr
IR _{bc} (child beef ingestion rate) kg/yr	IR _{ba} (adult beef ingestion rate) kg/yr
5 IR _{pc} (child poultry ingestion rate) kg/yr	35.8 IR _{pa} (adult poultry ingestion rate) kg/yr
FI _b (fodder intake for beef cattle) kg/day dry weight	0.39 FI _{sb} (beef cattle soil intake) kg/day dry weight
FI _{wb} (beef cattle water intake) L/day	94.1 IR _{mc} (child milk ingestion rate) kg/yr
217.9 IR _{ma} (adult milk ingestion rate) kg/yr	FI _m (fodder intake for dairy cattle) kg/day dry weight

0.41 FI _{sm} (dairy cattle soil intake) kg/day dry weight	92 FI _{wm} (dairy cattle water intake) L/day		
0.3 S (fraction water content) L water/L pore space	(total soil porosity) L water/L pore space		
1.5 P (soil bulk density) kg/L soil	DF _w (dilution factor for drinking water) unitless		
NOTES:			
 SF_f=food ingestion slope factor (Risk/pCi). ra IR_s=age-adjusted ingestion rate (mg/day). TF_p=soil-to-plant transfer factor (pCi/g plant TF_b=plant-to-meat transfer factor (pCi/kg per TF_m=plant-to-milk transfer factor (pCi/kg per K_d=distribution coefficientr (L/kg). radionuc 	per pCi/g soil). radionuclide-specific r pCi/day). radionuclide-specific r pCi/day). radionuclide-specific		
 7. \(\lambda = \text{Decay constant (0.693/halflife) yr^1. Radionuclide-specific.} \) 8. The curie (Ci), the customary unit of activity, is equal to 3.7 x 10¹⁰ nuclear transformations per second. 1 picocurie (pCi) = 10⁻¹² Ci. The International System (SI) unit of activity is the becquerel (1 Bq =1 nuclear transformation per second). 			

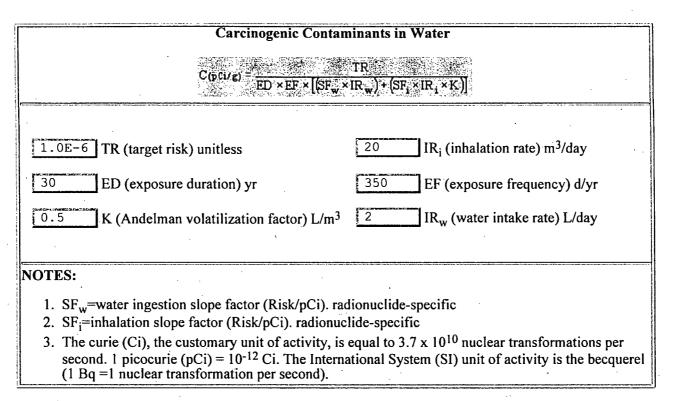
Outdoor Worker Soil



Indoor Worker Soil



Tap Water



Fish Ingestion

Carcinogenic Contaminants in Fish

 $C_{(pCUg)} := \frac{TR}{ED \times EF \times SF_f \times IR_f}$

1.0E-6 TR (target risk) unitless

IR_f (fish intake rate) g/day

30 ED (exposure duration) yr

350 EF (exposure frequency) day/yr

NOTES:

- 1. SF = food ingestion slope factor (Risk/pCi). radionuclide-specific
- 2. The curie (Ci), the customary unit of activity, is equal to 3.7 x 10¹⁰ nuclear transformations per second. 1 picocurie (pCi) = 10⁻¹² Ci. The International System (SI) unit of activity is the becquerel (1 Bq = 1 nuclear transformation per second).

Soil to Ground Water

METHOD 1

Partitioning Equation for Migration to Ground Water

$$SSL_{DC} = C_{\mathbf{w}} * \mathbf{10}^{-3} * \left(K_{\mathbf{a}} + \frac{\theta_{\mathbf{w}}}{\rho_{\mathbf{b}}} \right) * \frac{\mathbf{t} * \lambda}{(1 - \mathbf{e}^{-\mathbf{k}})}$$

dilution factor (used to calcualte C_w)

 $\theta_{\rm w}$ (water-filled soil porosity) $L_{\rm water}/L_{\rm soil}$

1.5 ρ_b (dry soil bulk density) kg/L t (time of exposure) yr

The dilution factor defaults to 20 for a 0.5-acre source. If you have all of the parameters needed to calculate a dilution factor, you may use method 2.

METHOD 2

Mass-Limit Equation for Migration to Ground Water

$$SSE_{DC} = \frac{C_{w}^{*} * I * ED * 10^{-3} * t * \lambda}{\rho_{b} * d_{s} * (1 - e^{-\lambda t})}$$

$$DAF = 1 + \left(\frac{K * i * d}{I * L}\right)$$

where:

$$d = (0.0112 * L^{2})^{0.5} + d_{2} * \{1 - e^{[-L^{+}]/(K^{++}d_{-})]}\}$$

I (Infiltration Rate) m/yr

ED (Exposure Duration) yr

1.5 Pb (dry soil bulk density) kg/L

d_s (average source depth) m - site-specific

30 t (time of exposure) yr

K (aquifer hydraulic conductivity) m/yr

i (hydraulic gradient) m/m

L (source length parallel to ground water flow) m

d_a (aquifer thickness) m - site-specific

For information about calculating site-specific values for the parameters included in the Mass-limit equations please refer to sections 2.6 and 2.7 of the Technical Background Document. Do not use this method unless you have values for all of the parameters.

Soil to Ground Water Notes

Method for Calculating Soil to Goundwater

Method 1

Method 2

O

NOTES:

1. Screening level equations have been modified to account for radioactive decay.

2. C_w(target soil leachate concentration) (mg/L or pCi/L) = nonzero MCLG, MCL, or HBL x dilution

- factor (which may be calculated or set to a site-specific default)

 3. K_d (soil-water partition coefficient) L/kg = radionuclide-specific
- 4. $\lambda = \text{Decay constant } (0.693/\text{halflife}) \text{ yr}^1$. Radionuclide-specific. 5. $10^{-3} = \text{conversion factor } (\text{kg/g})$

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